

**Exhibit 11 to Statement of Undisputed Facts Filed in Support of Motion of American  
Beryllia, Inc. For Summary Judgment**

**GOGOLEN AFFIDAVIT AND EXHIBITS**

UNITED STATES DISTRICT COURT  
FOR THE DISTRICT OF MASSACHUSETTS

CASE NO. 04-CV-12137 JLT

SUZANNE GENEREUX and BARRY  
GENEREUX, Individually and as Parents  
And Natural Guardians of their minor  
children, ANGELA GENEREUX and  
KRISTA GENEREUX,  
Plaintiffs

v.

AMERICAN BERYLLIA CORP., BRUSH  
WELLMAN, INC., BRUSH WELLMAN  
CERAMICS, INC., BRUSH WELLMAN  
CERAMIC PRODUCTS, INC., HARDRIC  
LABORATORIES, INC., KYOCERA  
AMERICA, INC., KYOCERA INDUSTRIAL  
CERAMICS CORP., and RAYTHEON  
COMPANY,  
Defendants

**AFFIDAVIT OF ROBERT GOGOLEN**

I, Robert Gogolen, under oath do hereby depose and say:

1. Between 1972 and 1999, I was employed at the Haskell, NJ facility of General Ceramics, Inc. in various capacities, including Production Supervisor, Engineering, and Drafting. I have personal knowledge of the facts contained in this Affidavit.

2. Between 1982 and 1990, General Ceramics sold a number of beryllium-containing products to Raytheon.

3. General Ceramics shipped metalized ceramic bushings to Raytheon between 1982 and 1990. The metalized ceramic bushings General Ceramics shipped to Raytheon were no larger than 1 ½ inches in diameter and had several different thicknesses. The metalized ceramic bushings sold to Raytheon between 1982 and

1990 had holes in them, were not windows, and had a different purpose than windows.

4. General Ceramics also shipped collectors to Raytheon between 1982 and 1990. The collectors General Ceramics shipped to Raytheon were no larger than 1 inch in diameter and 1 ¾ inches thick. The collectors sold to Raytheon between 1982 and 1990 had a blind hole down the middle, a hole in the side of the cylinder, were not windows and had a different purpose than windows.

5. I have reviewed the pertinent sections of the depositions of Suzanne Genereux, Al Broadbent, and Claire Balint, and their descriptions of the sizes of products with which Ms. Genereux worked. The descriptions of Suzanne Genereux, Al Broadbent, and Claire Balint do not match any products sold by General Ceramics to Raytheon between 1982 and 1990.

6. Although General Ceramics shipped windows to Raytheon between 1982 and 1990, the windows General Ceramics shipped to Raytheon were no larger than a ½ inch in diameter and .075 inches thick, much smaller than the 3" diameter discs Genereux described.

7. The majority of the beryllium-containing products sold to Raytheon between 1982 and 1990 by General Ceramics were pin squares. Pin squares are three-dimensional boxes. To the best of my memory, the maximum size of the pin squares that were sold to Raytheon in the 1980s was .10 in. x .10 in. x .50 in., much smaller than the "Tall Man" rectangular 1 ¼" x 1 ¼" x 2" boxes Genereux described. Pin squares are not windows, the products with which Suzanne Genereux worked. Pin squares have a different purpose than windows.

8. General Ceramics shipped its products to Raytheon in bulk, as requested by Raytheon.

9. All products shipped by General Ceramics to Raytheon contained warning labels. True and accurate copies of General Ceramics' warning labels are attached hereto as Exhibit A. All shipments containing beryllium from General Ceramics contained at least one of these warning labels.

10. General Ceramics also provided Raytheon with a Material Safety Data Sheet. A true and accurate copy of General Ceramics' MSDS is attached hereto as Exhibit B.

11. During the 1980s, General Ceramics knew that Raytheon had internal procedures regarding beryllium oxide. The plans and specifications Raytheon provided to General Ceramics between 1960 and 1995 contained details on the proper handling of beryllium oxide. True and accurate copies of plans and specifications containing this information are attached hereto as Exhibit C.

12. Raytheon's details on its plans and specifications demonstrated to General Ceramics that Raytheon was familiar with the properties and dangers of beryllium oxide.

13. General Ceramics was aware, from its own dealings with Raytheon, that Raytheon had its own procedures and policies in place to protect its own employees.

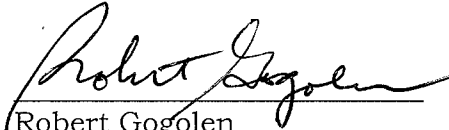
14. General Ceramics relied upon Raytheon to warn its own employees of the hazards of beryllium.

15. Between 1999 and 2001, I was not employed at either General Ceramics or American Beryllia. In 2001, I accepted a position at American Beryllia and am currently production manager.

16. Since its formation, American Beryllia has not sold any windows to Raytheon. Further, since its formation, American Beryllia has not sold any rectangular boxes, pin squares or otherwise, to Raytheon.

17. I am competent to testify to the matters herein.

SIGNED UNDER THE PAINS AND PENALTIES OF PERJURY THIS 19<sup>th</sup> DAY OF  
OCTOBER, 2006.

  
(Robert Gogolen)

**Exhibit A to Gogolen Affidavit**

## **BERYLLIUM PRODUCT**

### **POTENTIALLY HAZARDOUS MATERIAL**

Care should be taken to avoid inhaling dust or fumes. Secondary operations which can generate dust or fumes (such as abrading, chemical etching, lapping, grinding, scoring, or firing over 1000°C) must be performed in facilities which meet OSHA standards.

## **BERYLLIA CERAMIC**

**DANGER — INHALATION OF DUST OR FUMES MAY CAUSE SERIOUS CHRONIC LUNG DISEASE**

**POTENTIAL CANCER HAZARD BASED PRINCIPALLY ON ANIMAL TESTS**

This product contains beryllium and may contain nickel. Overexposure to beryllium by inhalation may cause berylliosis, a serious chronic lung disease. Hazard Communication Regulations of the Occupational Safety & Health Administration require that caution labels for materials listed as potential carcinogens in either the International Agency for Cancer Research Monograph Series or the National Toxicology Program Annual Report on Carcinogens must contain a cancer warning. Beryllium and nickel have been so listed.

- If processing produces dust or fumes, use only with exhaust ventilation or other controls designed to meet OSHA standards.
- Sold for manufacturing purposes only.

See Material Safety Data Sheets on file with your employer for further details concerning OSHA standards and precautionary measures.

Assistance in establishing safe procedures may be obtained by contacting General Ceramics Inc., First Avenue, Haskell, N.J. 07420, Tel.: 201-839-1600.

**Exhibit B to Gogolen Affidavit**



**MATERIAL SAFETY DATA SHEET****SECTION I — IDENTIFICATION**

National Beryllia Division  
GENERAL CERAMICS, INC.  
First Avenue  
Haskell, NJ 07420

Telephone: CHEMTREC 800-424-9300  
General Ceramics : 201-839-1600

Product Name: K150 BERLOX  
Common Name & Synonyms: Beryllia  
Chemical Name: BERYLLIUM OXIDE  
Formula BeO

Hazard Rating	
Least	Slight
0	1
Moderate	High
2	3
Extreme	
4	

Health 2

Fire 0

Reactivity 0

**SECTION II — HAZARDOUS INGREDIENTS**

INGREDIENT	PERCENT	C.A.S. NO.
BERYLLIUM OXIDE	99.5	1304-56-9

**SECTION III — OCCUPATIONAL STANDARDS (BERYLLIUM)**

(All Concentrations Are As Micrograms per Cubic Meter Of Air)

Substance	OSHA			ACGIH	
	PEL	CEILING	PEAK	TLV	TLV-STEL
BERYLLIUM	2	5	25	2	N/A

ACGIH = American Conference of Governmental Industrial Hygienists  
 PEL = Eight Hour Average Permissible Exposure Limit  
 CEILING = Not To be Exceeded Except For Peak Limit  
 PEAK = 30 Minute Maximum Duration Concentration Above Ceiling Limit  
 TLV = Eight Hour Average Threshold Limit Value  
 TLV-STEL = 15 Minute Short Term Exposure Limit  
 (C) = ACGIH Ceiling Limit—Not To Be Exceeded  
 N/A = Not Applicable

**SECTION IV — GOVERNMENTAL REGULATIONS****EPA EMISSION STANDARD (As Beryllium) —**

0.01 Micrograms per cubic meter (30 day average) Ambient  
 Air Standard  
 10 Grams/24 Hrs. Total Site Emission Limit

**DOT SHIPPING REGULATIONS —**

No special Requirements

**EPA WASTEWATER REGULATIONS —**

None—Regulations are Pending

NOTE: State and Local Regulations may vary

## SECTION V — HEALTH HAZARDS

**Effects of Over-Exposure:** Inhalation of Beryllium Oxide Powder may cause berylliosis, a serious chronic lung disease, with cough, chest pain, shortness of breath, weight loss, weakness, and fatigue. Beryllium-containing materials have been listed by the National Toxicology Program Annual Report on Carcinogens, and the International Agency for Research on Cancer Monograph as a potential carcinogen (cancer producing agent). Handling of solid shapes presents no dermatitis or skin absorption problem.

## SECTION VI — EMPLOYEE PROTECTION

**Respiratory Protection:** NIOSH approved high efficiency cartridge or supplied air mask is required if Beryllium in air concentrations exceeds OSHA standards.

**Eye Protection:** None required except as related to normal operations.

**Protective Gloves:** None normally required.

**Other Protective Equipment:** Personnel performing operations where there are exposures to dust, mists, or fumes should be provided full-body protective clothing.

**Ventilation:** Provide adequate local exhaust ventilation when performing operations such as machining, grinding, laser trimming, sand blasting, chemical etching, etc. where respirable dusts, mists, or fumes are generated. Powdered materials must be stored in sealed containers; transfers must be made in ventilated hoods. Operations generating airborne material must be air sampled to determine exposure levels. Medical surveillance should be conducted for employees where warranted by exposure date. Concentrations of suspended Beryllia in liquid coolants used for machinery should be kept low to avoid particulate matter from becoming airborne.

## SECTION VII — FIRST AID

**Skin Contact:** Properly clean any contaminated clothing. Wash body especially under folds of skin and fingernails. Cover any open wounds to avoid infections. Dermatitis from handling is usually limited to abrasion.

**Eye Contact:** Flush eye with Boric Acid Solution for approximately 20 minutes.

**Inhalation:** Remove from source of exposure, have sinus cavities flushed by qualified physician.

**Ingestion:** Fired, solid Beryllium Oxide Ceramics are indigestible.

## SECTION VIII — FIRE AND EXPLOSION DATA

Flash Point (method used): N/A

Flammable Limits: LEL N/A UEL N/A

Extinguishing Media Water

Special Fire Fighting Procedures None

Unusual Fire and Explosion Hazards None

**SECTION IX — SPECIAL PRECAUTIONS**

**Precautions for Handling and Storing:** Store in closed containers. Handling solid Beryllium Oxide ceramics is harmless so long as they are kept dust-free. Avoid any operations which would create respirable dust or mists.

**Spill or Leak Precautions:** Clean any loose material using wet cleaning or properly equipped vacuum cleaner supplied with Hepa filters. Personnel involved in cleanup should wear proper respirator and protective clothing.

**SECTION X — WASTE DISPOSAL METHOD**

Because of its value Beryllium Oxide scrap is normally recycled. In cases where economics do not justify the segregation of Beryllium Oxide scrap for resale, solid material may be landfilled. Because of the potential inhalation hazard of handling this material as a discarded powder (such as baghouse fines) we recommend it be: 1) Sealed in two plastic bags, 2) placed within a DOT container approved for Poison B compounds, 3) label the outer container with the appropriate DOT Hazard Warning Labels, and 4) Ship to an approved hazardous waste disposal site.

**SECTION XI — PHYSICAL DATA**

Boiling Point (°F) N/A	Vapor Pressure (mm/Hg) N/A	Spec Gravity (H <sub>2</sub> O = 1) 2.85
Vapor Density (Air = 1) N/A	Evaporation Rate (Water = 1) N/A	Solubility in Water N/A
Percentile Volatile by Volume N/A	Appearance: White Solid	
Molecular Weight: 25.01	Melting Point: 2547°C	

**SECTION XII — REACTIVITY DATA**

Unstable



Stable

Hazardous  
PolymerizationMay  
OccurWill Not  
Occur

**Conditions and Materials to Avoid:** Volatile Beryllium Hydroxide can be formed when firing solid Beryllium Oxide parts at high temperatures (over 1200°C) and in moist atmospheres.

**Hazardous Decomposition Products:** None, except as noted above.

**SECTION XIII — REFERENCES**

ACGIH:

**Exhibit C to Gogolen Affidavit**

**Inspection / Test Procedure**

RA THEON

*Raytheon*

## INSPECTION / TEST PROC.

FILE NO.: VOCE 6286

ITEM: Window, Radio Frequency

PART OF: MSR

INSPECTION/TEST AREA: Incoming Mech.

TEST STATION NO.:

ISSUE NO.: A-11215328-0-Rev. *4*

ISSUE DATE: October 18, 1966

HAZARDOUS MATERIAL  
CAUTION - SPECIAL HANDLING  
See Page #2

## SOURCE OF PERFORMANCE SPECIFICATION

*FOR NBC #CM-2705*

SQAP:

MPD:

MPB REVISION NO.:

SCHEMATIC:

PRODUCT PRINT NO.: C-11215328-Rev. *SE**EO 71-43729*

ORIGINATED BY C.R. Keyes	REVISED BY <i>C.R. Keyes</i> C.R. Keyes	QA CONFIRMATION <i>OK</i>
APPROVED BY <i>S. Martvelias</i>	DATE APPROVED <i>10-18-66</i>	

*A-11215*

FORM NO 4613D



## INSPECTION / TEST REPORT

ITEM: Window, Radio Frequency  
A-11215328CHAR  
NO.CHARACTERISTIC /  
DIMENSION / TESTHAZARDOUS MATERIAL

Do not attempt to open packages or inspect parts until parts have been cleaned per MPB 11215328

"Special process to clean incoming material prior to inspection."

Inspection must be performed in the MSR Assembly area by a designee of, and monitored by the beryllium control coordinator. Finger cots or gloves must be used at all times when handling parts. Parts are extremely brittle and fragile and care should be taken in handling as not to chip, crack, or break parts.

Broken windows are to be reported to the control coordinator at once.

Reference General Procedure #37-3006-172

"Beryllium Oxide, Handling Of."

UNCLASSIFIED

FORM NO. 4613D

**INSPECTION / TEST PROC****RAYTHEON**ITEM: Window, Radio Frequency  
A-11215328

CHAR NO.	CHARACTERISTIC / DIMENSION / TEST
1	<u>INSPECT FOR:</u> (A) Part number identification (B) Damage (C) Additional requirements on purchase order such as CSL, DCN, Packaging Specs, etc. (D) Manufacturers name and/or symbol.
	Assure that inspection equipment is within the Calibration M-day due.
2	<u>MATERIAL:</u>  Ceramic -- Beryllia Molded
3	<u>PROTECTIVE FINISH:</u> (A) <u>Finish:</u> Metallize with Moly-Maganese & Nickel Plate  (B) <u>General Workmanship of Finish:</u> The nickel plating shall be smooth, fine grained, adherent, and free from visible blisters, pits, nodules porosity, indications of burning and excessive edge build-up. Slight discoloration resulting from baking shall not be cause for rejection.

Cer.  
whi.WITHOUT VISUAL  
AIDS

UNCLASSIFIED



FORM NO. 4613D



## INSPECTION / TEST

ITEM: Window, Radio Frequency

A-11215328

CHAR. NO.	CHARACTERISTIC / DIMENSION / TEST
	<del>The Inspector shall examine each part for the following:</del>
	<del>A - Voids in metalized area</del>
	<del>B - Overrun or splatter of metalizing agent</del>
	<del>C - Cracks and chips</del>
	<del>D - Flaking or pooling of metalizing</del>
	<del>E - Foreign material</del>
4	Break sharp edges .00 - .01 NOTE: Check visually for evidence of broken edges; if break appears excessive, use comparator to check .00 - .01
5	1.608 - 1.611 O.D. NOTE: Check part at least three places around O.D. to assure part is not out-of-round beyond tolerance. Part must be turned over and checked on both sides to assure dia. does not taper over or under dia. tolerance.
6	.153 - .157 Thickness NOTE: Check in numerous places to assure part does not taper out of tolerance.
7	.26 - .30 Length of metalized
8	<del>.012 - .013</del> Width of Metalized .12 - .10

UNCLASSIFIED

FORM NO. 4613D



## INSPECTION / TEST P.

ITEM: Window, Radio Frequency  
A-11215328

CHAR NO.	CHARACTERISTIC / DIMENSION / TEST
9	.00 - .02 Allowable cut-back of metalizing on O.D. (2 Places)
10	<p>The .26 - <sup>.30</sup><del>.27</del> Dim., at Max. material condition, to be symmetrical to Dia. -A- (1.608 - 1.611 dia. regardless of feature size (within .01)</p> <p>NOTE: The .01 symmetry tolerance may be exceeded by the amount the .26 <del>.30</del> dimension is under the .30 maximum.</p>
11	<p><sup>.10 - .12</sup> The <del>.05</del> - <del>.05</del> dimension, regardless of feature size, to be symmetrical to dia. -A- (1.608 - 1.611 dia.) Regardless of datum size, within .01</p>
12	<p><del>Complete I.T.R. Form No. 4665</del> <del>Ballpoint Pen</del></p> <p>VOIDS, FLAKING, OR PEELING OF METALIZING</p> <p>NOTE: THE INSPECTOR SHALL EXAMINE THE METALIZED AREA VISUALLY FOR VOIDS. IF A VOID APPEARS GREATER THAN 1/64" IT SHOULD BE MEASURED WITH A SCALE. NO VOID OR COMBINATION OF SHALL BE GREATER THAN</p>

SEE FIG #1 UNCLASSIFIED  
FIG #2

FORM NO 4613E

INSPECTION / TEST

ITEM:

CHAR NO.	CHARACTERISTIC/ DIMENSION / TEST
13	<p>CRACKS &amp; CHIPS</p> <p>THE INSPECTOR SHALL EXAMINE THE PARTS VISUALLY FOR CRACKS AND CHIPS - IF THE CHIPS APPEAR VISUAL TO EXCEED AN AREA OF .063 SQUARE OR .015 DEEP IT SHOULD BE MEASURED <sup>USING</sup> THE .063 SQUARE TEMPLATE OF 6" SCALE. MORE THAN FIVE CHIPS AROUND THE DIA. WHICH ARE VISUAL <u>WITHOUT THE AID OF MAGNIFICATION</u> ARE NOT ACCEPTABLE REGARDLESS OF SIZE.</p> <p>SEE FIG #:</p>

UNCLASSIFIED

FORM NO 4613E



## INSPECTION / TEST

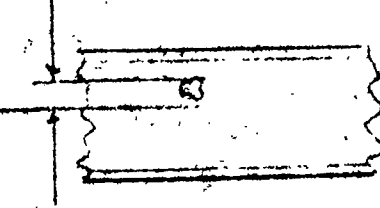
ITEM:

CHAR NO	CHARACTERISTIC/ DIMENSION / TEST
14	<p>FOREIGN MATTER TO CONSTITUTE AN UNACCEPTABLE CONDITION. FOREIGN MATTER EITHER IMBEDDED OR ON THE CERAMIC OR METALIZING <u>MUST BE VISUAL WITHOUT</u> <u>THE AID OF MAGNIFICATION</u> AND SHOULD NOT BE REMOVABLE WITH A SOFT RUBBER ERASER.</p>
15	<p>OVER RUN MD/OIL SPLATTER. TO CONSTITUTE AN UNACCEPTABLE CONDITION OVER RUN (METALIZING OF OIL RUNNING OVER ON FACE OF AND SPLATTER OF METAL <u>MUST BE VISUAL WITH</u> <u>THE AID OF MAGNIFICATION.</u></p>
	<p>COMPLETE ITR FORM #4665</p>

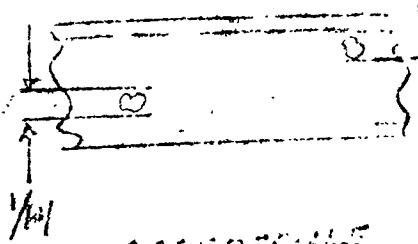
UNCLASSIFIED

# FIG #1 AROUND DIAM.

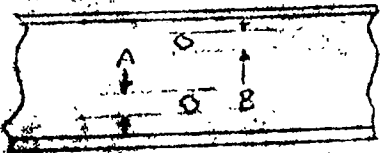
WITHIN  $\frac{1}{64}$



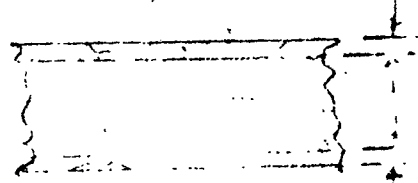
ACCEPTABLE



ACCEPTABLE

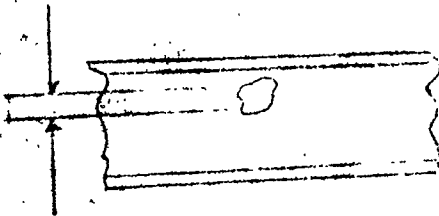


A+B IS LESS THAN  $\frac{1}{64}$   
IF BOTH VOIDS ARE  
IN LINE IS  
ACCEPTABLE



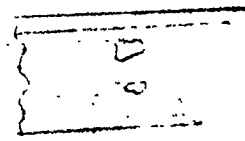
VOIDS ACCEPTABLE  
WITHIN .020 OF TC  
OR BOTTOM SURFACE

GREATER  
THAN  $\frac{1}{64}$



UNACCEPTABLE

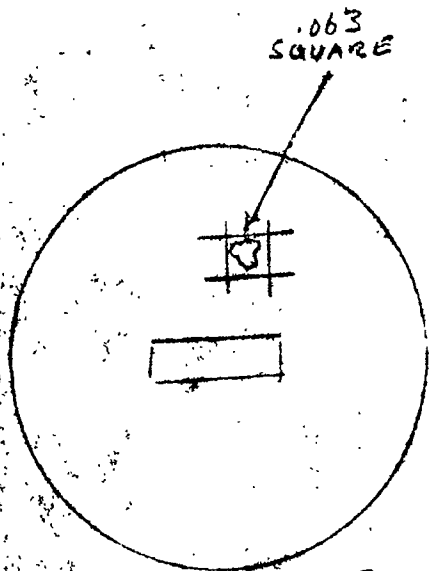
A  
B



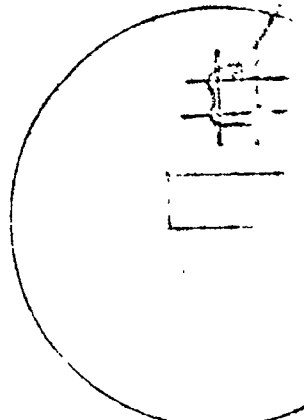
A+B IS GREATER  
THAN  
IF BOTH VOIDS  
ARE IN LINE  
UNACCEPTABLE

FIG 3

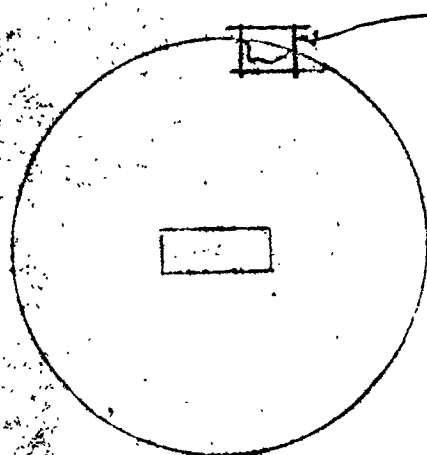
CHIPS



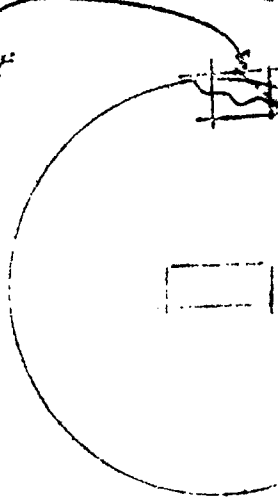
ACCEPTABLE



UNACCEPTABLE



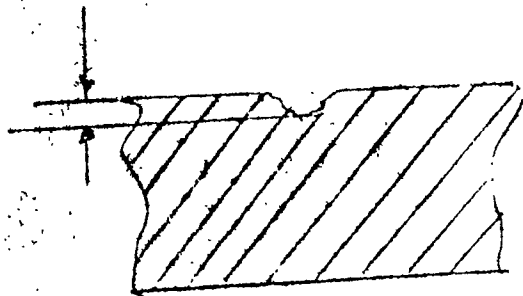
ACCEPTABLE



UNACCEPTABLE

OVER DIS

DEPTH



UNACCEPTABLE

**Material Purchasing Specification, Metalized Beryllium Oxide Ceramics**

# MATERIAL PURCHASING SPECIFICATION

## METALIZED BERYLLIUM OXIDE CERAMICS

### 1.0 GENERAL

#### 1.1 Purpose

- 1.1.1 To cover the specifications of ceramics and metalized ceramics used in high power long life vacuum tube manufacture.

#### 1.2 Scope

- 1.2.1 This specification covers the requirements for dense, non-porous, beryllium oxide ceramic parts and metal coatings on ceramic parts used in high power long life vacuum tubes.
- 1.2.2 In any and all respects not covered by this specification, the material shall be in accordance with the standard practice of the supplier.

### 2.0 APPROVAL

- 2.1 Usage - The behavior of the material is to be similar to that of lots previously received and approved by Raytheon Company.
- 2.2 Lot Identification - Raytheon Quality Assurance and the vendor will establish, through mutual agreement, the definition of a lot for the purposes of Acceptance inspection and/or test. The vendor will submit, by letter, his method of lot control and lot identification. This control and identification shall be such that the lot is traceable to the major variables in his processing. Units of product within one lot shall be homogeneous for these variables. Raytheon Quality Assurance will review the vendor's method and, upon reaching an agreement, will indicate approval by letter. The approved lot definition and lot identification will become a part of this specification. Record of the letters will be indicated on the purchase order.

In the absence of prior mutual agreement between Raytheon Quality Assurance and the vendor, each shipment will be considered a lot subject to acceptance or rejection.

#### 2.3 Packaging and Shipment of Parts by Vendor

- 2.3.1 Parts shall be cleaned by Vendor prior to shipment (preferably by Ultrasonics.)
- 2.3.2 Packing material shall be free from dusts of beryllium and its compounds.

		C B B B B B C		REV. LTR.	REV. STATUS
		7 6 5 4 3 2 1		SHEET NO.	OF SHEETS
NAME	DATE	METALIZED BERYLLIUM OXIDE CERAMICS		<b>RAYTHEON</b> LEXINGTON, MASS. 02173 655039	
L. Turabing	16-22-67				
L. Turabing	1-29-70	CM-229946A 2310		CODE 49956 SH 1 of 7	
APPROVED	1				

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REVISIONS: 01-29-70



- 2.3.3 Parts shall be sealed in clear polyethylene plastic bags.
- 2.3.4 Outside of package shall be marked with Purchase Order No., Part No., and Quantities.
- 2.3.5 Three copies of an inspection certificate of compliance to Sections 3.0 and 4.0 shall be submitted with each shipment. These, along with the packing slips to be contained in the shipping unit.
- 2.3.6 The following shall be placed on the outside of each package:

1. "Contains Beryllium Oxide."
2. "Do not open package."
3. "On receipt, deliver to Thoria Mixing Room."

3.0 The following chemical, electrical and physical properties are for reference only.

### 3.1 Chemical Composition

3.1.1 The beryllium oxide content is to be 99.5% minimum.

### 3.2 Electrical Properties

### 3.2.1 Dielectric Constant (K)

		316°C	649°C	871°C
		600°F	1200°F	1600°F
10,000 mc	Room Temp.	6.5	6.7	7.0
	6.5			

### 3.2.2 Loss Tangent ( $\tan \delta$ )

		316°C	649°C.	871°C
	Room Temp.	600°F	1200°F	1600°F
10,000 mc	0.0010	0.0011	0.0015	0.0016

NOTE: The Dielectric Constant and Loss Tangent results are based upon measurements obtained using a shorted waveguide technique.

The maximum variation is not to exceed  $\pm 5\%$  of values for dielectric constant and loss tangent.

### 3.2.3 Dielectric Strength (volts/mil)

Room Temperature 500

NOTE: The Dielectric strength is measured using a 0.030 inch thick specimen (A.S.T.M. test D 667-44T)

### 3.3 Electrical Resistivity (ohm-cm)

Room Temperature

200°C (392°F)

$$\begin{array}{l} 2 \times 10^{16} \\ 2 \times 10^{14} \end{array}$$

NAME <i>L. Turner</i>	DATE <i>6-22-67</i>	METALIZED BERYLLIUM OXIDE CERAMICS	RAYTHEON	LEXINGTON MASS. 02173
			655039	
APPROVED			CODE 49956	SH 2

EVISIONS: A - 44-1181-514167 - B - CORR. - 118150 A.M. - 8-25-67 M

4.0 PHYSICAL PROPERTIES

4.1 Density (g/cc)	2.86-2.95
4.2 Water Absorption	0.0
4.3 Color	Off White
4.4 Modulus of Rupture (p.s.i.)	25,000
4.5 Tensile Strength (p.s.i.)	13,000
4.6 Compressive Strength (p.s.i.)	150,000
4.7 Melting Point (4620°F) (2549°C)	
4.8 Safe Temperature Continuous Operation (3400°F) (1871°C)	
4.9 Specific Heat (Btu/lb.)	0.30
4.10 Thermal Conductivity (Btu/hr/ft <sup>2</sup> /°F/ft)	

Room Temperature

600°F (316°C)  
1500°F (816°C)

140

60

25

4.11 Thermal Expansion (in/in/°F)

Room Temperature to 500°F (260°C)

4.1 x 10<sup>-6</sup>5.0 VISUAL REQUIREMENTS

Parts to be examined under 10X magnification for surface imperfections.

5.1 Definition - Surface Imperfections

- 5.1.1 Pit - A microscopic or macroscopic cavity completely open on any surface (exclusive of edges) that does not retain dye penetrant.
- 5.1.2 Pore/Pock - A microscopic orifice smaller than .005 inch that has the ability to retain a dye penetrant. The depth of this "pore" can be finite (forming a cavity) or infinite (continuous from one surface to another).
- 5.1.3 Open Chips - An open cavity located along the edges. This designation is strictly confined to corner-like edges.
- 5.1.4 Closed Chips - A partially closed cavity located along the edges. This designation is confined to corner-like edges.
- 5.1.5 Crack - A fissure that retains dye penetrant.
- 5.1.6 Gouge or Scratch - A shallow groove-like blemish (macro- or microscopic) that does not retain dye penetrant. This designation does not apply to corner-like edges.
- 5.1.7 Blemishes-Spots - Any imperfection, discoloration or spots caused by the inclusion of foreign material in the ceramic.
- 5.1.8 Dent - Small depression on any ceramic surface exclusive of edges.
- 5.1.9 Potential Chips - (Closed Chip) - A chip that has not broken off completely.
- 5.1.10 Flaws - Designated to include all imperfections (unless otherwise specified) such as pits, pores, pocks, dents, etc. in "critical area."

NAME	DATE
<i>L. Turner</i>	6-22-67
APPROVED	

METALIZED BERYLLIUM OXIDE CERAMICS

RAYTHEON

LEXINGTON  
MASS.  
02173

655039

CODE 49956 SH 3

REVISIONS: A - NEW #421-54409 B - CORR. - MPAISO ADDED - 7-25-67

PRINTED IN U.S.A.

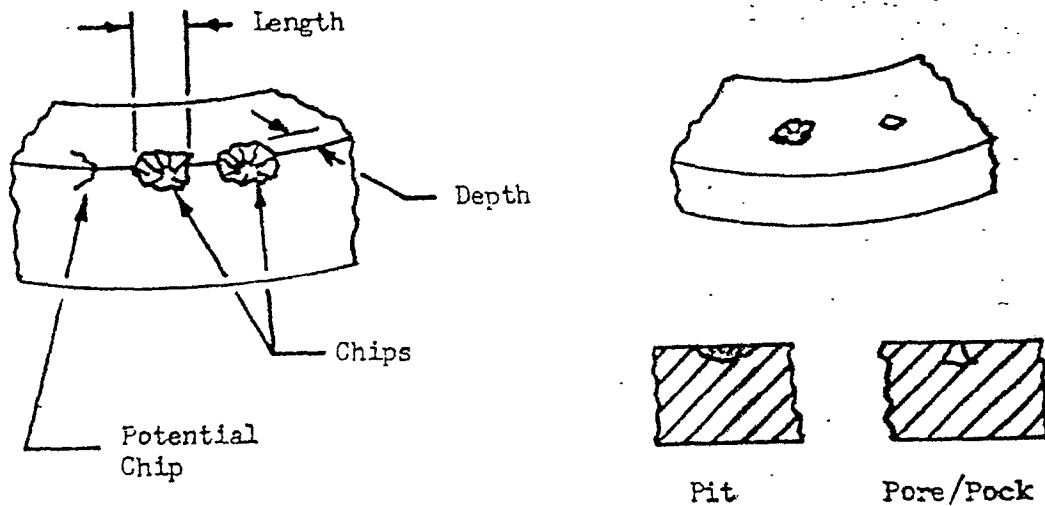
10-0706 VELLUM  
FORM NO. 10-0706 VELLUM  
10-0

### 5.1.11 Adhered Foreign Material

5.1.11.1 Burr - A protruding foreign particle fused onto the ceramic surface.

5.1.11.2 Fins or Flashings - Excess materials adhering onto the sides, ends, or edges of ceramic.

5.1.12 Bleb - A small blister or mound-shaped projection on the ceramic surface or metal coated surfaces caused by the inclusion of air or other gases or foreign matter.

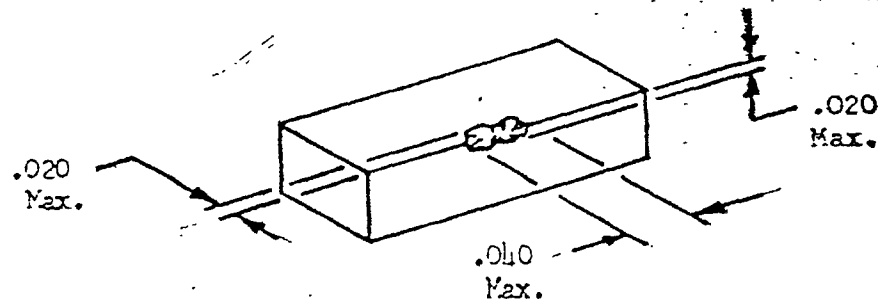


### 5.2 Non-Critical Area Requirements (Applies to those surfaces which are not Metalized)-

#### 5.2.1 Chips (Open and Closed)

5.2.1.1 Chips of depth less than .015 shall not be considered cause for rejection.

5.2.1.2 Chip dimensions shall not exceed those shown in figure. The total number of chips shall be limited to 1 per edge.



NAME	DATE
<i>L. Turley</i>	<i>1-22-67</i>
APPROVED	

METALIZED BERYLLIUM OXIDE CERAMICS

RAYTHEON

LEXINGTON  
MASS.  
02173

655039

CODE 49956 SH 4

R - 2000 - NPH:50 ADDED - 7-25-67

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10-0706  
10-0707 G  
10-0708 FILM

IRM NO.

- 5.2.2 Potential Chips (Closed) - There shall be none.  
5.2.3 Dents -

- 5.2.3.1 Dents less than .015 maximum in depth shall not be considered cause for rejection.  
5.2.3.2 Depth of other dents shall be limited to .020.

5.2.4 Pits -

- 5.2.4.1 Pits less than .015 maximum at the opening shall not be considered cause for rejection.  
5.2.4.2 Depth of pits shall be limited to .020 maximum.  
5.2.4.3 Pock/Pore - The area of dye penetrant surrounding a pock or pore shall not exceed .020 maximum in diameter.

5.2.5 Gouges and Scratches -

- 5.2.5.1 Gouges and Scratches less than .002 maximum in depth shall not be considered cause for rejection.  
5.2.5.2 Depth of other gouges and scratches shall be limited to .015 maximum. The number of gouges and scratches shall not exceed 2.

5.2.6 Cracks.- There shall be no cracks or fissures.

5.2.7 Blebs/Blisters - There shall be none.

5.2.8 Adhered Foreign Material - There shall be none.

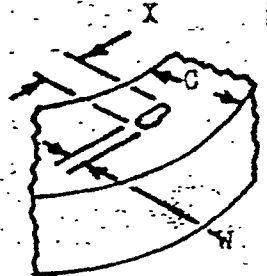
\* 5.2.9 Blemishes and Spots - There shall be none.

5.1.7: Recent parts are of acceptable standard.  
5.3 "Critical Area Requirements" - Judgement quite subjective

(Applies to surfaces to be metalized as designated on the individual part drawing).

5.3.1 Flaws -

- 5.3.1.1 There shall be no flaws in the critical area "C" in excess of  $W = .020$  max.  $x = .020$  wide.  
5.3.1.2 The number of flaws shall not exceed 2.  
5.3.1.3 The depth of any flaw in a critical area shall not be greater than .010.  
5.3.1.4 There shall be no more than one flaw across the critical area "C". Any two adjacent flaws must be separated by .200.  
5.3.1.5 Potential Closed Chips - There shall be none.  
5.3.1.6 Cracks - There shall be none.  
5.3.1.7 Blemishes and Spots - There shall be none.  
5.3.1.8 Adhered Material - There shall be none.  
5.3.1.9 Blebs/Blisters - There shall be none.  
(Applies to coating as well).



NAME <i>L. Turney</i>		DATE <i>6-22-67</i>		METALIZED BERYLLIUM OXIDE CERAMICS		RAYTHEON		LEXINGTON MASS. 02173	
APPROVED						655039		CODE 49956 SH 5	

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10-0706  
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FORM NO. 10-0706  
10-0707  
10-0708

REVISIONS-A-10-0706-10-0707-10-0708-B-CORR. - MPAISO ADDED - 7-25-67

**6.0 METAL COATINGS (ON CERAMIC)****6.1 Types of Coatings**

6.1.1 Each type of coating shall conform to the applicable part drawing.

**6.2 Areas to be Coated**

6.2.1 The coated areas shall conform to the specified limits on applicable part drawing.

**6.3 Thickness of Coating**

6.3.1 The thickness of each coating shall be as specified on the applicable part drawing.

\* **6.4 Visual Requirements** - Coatings to be examined under a 10X magnification for imperfections.

\* 6.4.1 Chipped Coatings - There shall be none.

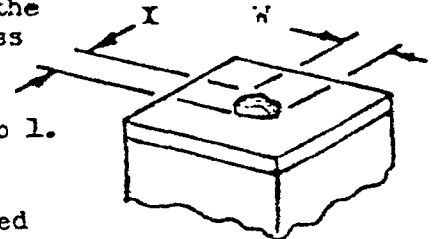
6.4.2 Pitted Coating - The depth of pitted area shall be limited to the thickness of the specified metalizing and must be in an area other than at corner or edge.

6.4.2.1 There shall be no depression in the coated critical area "C" in excess of  $W = .020$  and  $X = .020$ .

6.4.2.2 The number of depressions in any critical area shall be limited to 1.

6.4.2.3 Any depressions spaced closer in any location than the depression maximum dimension will be measured across the most extreme ends.

6.4.2.4 Single small depressions will not be considered if their dimensions do not exceed the following maximum limits:  
 $X = .010$      $W = .010$ .



\* 6.4.3 Lumpy Coating - There shall be none.

\* 6.4.4 Blebs/Blisters - There shall be none.

\* 6.4.5 Poor Adhesion - There shall be no peeled plating as evidenced by detachment of the plating from the base metal.

\* 6.4.6 Bare Spots - There shall be no bare spots in the plating.

\* 6.4.7 Stains, Foreign Material and Uniformity

6.4.7.1 Stains.- There shall be no discoloration of the plated metal surface which may be in the form of either bleeding out, finger prints, grease, or gas streaks.

6.4.7.2 Foreign Material.- There shall be no foreign material such as plating salts, lint or masking material.

6.4.7.3 Plating shall be of a uniform color characteristic of the metal used.

NAME <i>L. Twigg</i>		DATE <i>6-22-67</i>	METALIZED BERYLLIUM OXIDE CERAMICS	RAYTHEON	LEXINGTON MASS. 02173
				655039	
APPROVED				CODE 49956	SH 6

PRINTED IN U.S.A.

 10-11-67  
 FORM NO. 10-11-67  
 10-0766 FILM

REVISIONS: A ECA 421 5/4/67

# 6.4.8 Adherence and cohesive strength of coatings and ceramic.

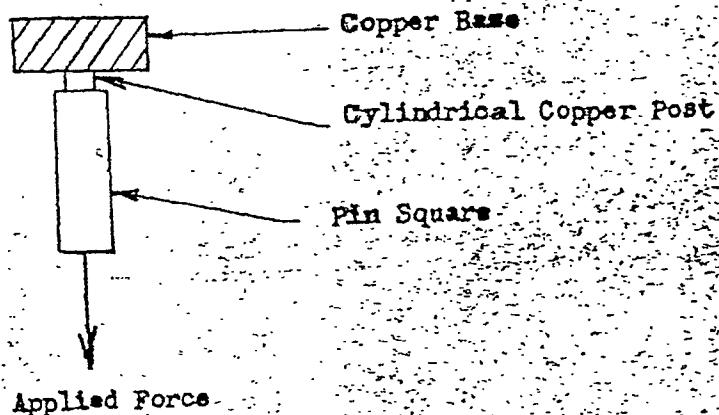
6.4.8.1 A sample of 0.1% of the quantity of each lot or a minimum of 10 pieces of incoming parts is to be subjected to a tensile pull test. The pull test specimen must be made in accordance with the following details:

6.4.8.1.1 A cylindrical copper post having a diameter of approximately 0.5 the width of the Pin Square and a length of .015" MIN. is to be silver plated, .0002 to .0004 inches thick.

6.4.8.1.2 The post is to be brazed to the center of one end of the Pin Square in a hydrogen atmosphere at 825°C. The resultant brazed assembly must have no voids in the solder joint between the post and pin, examined under 10X magnification.

6.4.8.1.3 The assembly is to be rebrazed in a hydrogen atmosphere at 825°C to a ridged copper base having a silver plated (.0002 to .0004 thick) brazing surface suitable for holding in a tensile pulling device. The resultant brazed assembly must have no voids in the solder joints between the pin and post, or post and base, examined under 10X magnification.

6.4.8.1.4 The ceramic to metal joint (plating to metalizing band, metalizing to ceramic band) must be capable of withstanding a tensile pull test of a minimum of 17,700 PSI.



6.4.8.2 No changes in the processes, materials and techniques used in the manufacture of the part shall be allowed unless approved by MPT Engineering.

FORM NO. 30-17 SHEET 2

NAME <i>L. Trenchard</i>	DATE 1-27-70	METALIZED BERYLLIUM OXIDE CERAMICS	RAYTHEON	LEXINGTON MASS. 02173
APPROVED			655039	CODE 49956 SH 7

REVISIONS: C - ECN 929 - 1-27-70

## **Handling Specification**



SENT BY: A

9-15-87 1:26PM

01/04/99

HANDLING SPECIFICATION

1.0 SCOPE: This specification defines requirements for beryllium oxide (beryllia) rods. This material shall be identified by Raytheon as B713D.

1.1 COMPOSITION: Proprietary (99.5% Min. Beryllium oxide).

1.2 MATERIAL IDENTIFICATION:

Each variation or combination of variations to which this material shall conform will be identified by a suffix assignment as listed below. The column headed "Description" lists only the special requirements, i.e. tolerances, properties, etc., that pertain to a specific material and values or limits for such are presented in Section 2.2 under the appropriate headings with specific suffix listings. If no special requirements apply, the word "Standard" is entered in the "Description" column and requirements are presented in Section 2.1. When not specifically mentioned, standard criteria apply for such categories.

SUFFIXDESCRIPTION

B713D1

Standard

2.0 REQUIREMENTS:

2.1 STANDARD REQUIREMENTS

2.1.1 TOLERANCES: Appropriate part drawing must accompany this specification.

2.1.2 PROPERTIES: The values shown below shall be average values for test pieces.

2.1.2.1.6 PURITY: 99.5% or greater beryllium oxide

2.1.2.3 PHYSICAL PROPERTIES

2.1.2.3.1 DENSITY: A typical value is 2.858 g/cc.

2.1.2.3.3 Coefficient of Thermal Expansion- Typical value  $3.2 \times 10^{-6}$  in/in/°F, 25° to 200°C.

2.1.2.3.4 THERMAL CONDUCTIVITY:

Typical value

BTU- in/ft<sup>2</sup>/hr./°F

20°C

1741.8

100°C

1306.3

400°C

580.6

2.1.2.3.5 WATER ABSORPTION: Impervious (0 - .02%)

2.1.2.4 ELECTRICAL PROPERTIES

FORM NO. 36-0727 SHEET 1

NAME SM FOSTER		DATE 16 APR 88	REV. LTR. A A		REV. STATUS OF SHEETS
APPROVED			SHEET NO. 21		
BERYLLIUM OXIDE ROD			RAYTHEON		LEXINGTON MASS. 02173
			33-B-713D		
			CODE 49956		SH 1 OF 2

REVISIONS: "A" SEN 12642 16 APR 88



2.1.2.4.4 DIELECTRIC CONSTANT: Typical value 6.6 - 7.7 @ 10 GHz.

2.1.2.4.5 LOSS TANGENT: Typical value .0003 - .0013 @ 10 GHz.

2.1.2.4.10 DIELECTRIC STRENGTH: 485 volts/ mil @ .050 thickness.

### 2.1.3 PACKAGING

2.1.3.1 PACKING: This material shall be supplied in the simplest commercial packaging which will prevent damage and contamination through shipping and handling. This will be consistent with Section 6.1. Glass containers and polyethylene or nylon bags (only if unplasticized) are acceptable.

2.1.3.2 MARKING: Each container shall be marked with quantity, Raytheon part nomenclature, material nomenclature, and marked to conform to appropriate safety requirements.

### 3.0 REFERENCES

3.2 PROPRIETARY NOMENCLATURE: Coors Porcelain Co. BD995, Brush Beryllium Co. Thermalox 995 or equivalent.

4.0 ORDER: Quantity, Raytheon material identification no. (e.g. B713D1) to conform to part 1.0 and 2.0 of this specification.

### 5.0 INSPECTION AND TESTING

#### 5.1 SAMPLING

5.1.1 Sampling for Incoming Inspection

5.1.1.1 Check each shipment for category specified in Section 5.2.1.1.

5.1.2 Sampling for Chemical and Physical Laboratory Testing.

5.1.2.1 Send a sample from each shipment of parts made of B713D to the laboratory for physical testing.

#### 5.2 TESTING

5.2.1 Testing and inspection by Incoming Inspection

5.2.1.1 Check shipment for dimensions against part specification.

5.2.1.2 Do not use lubricants and handle parts with gloves or tweezers only.

5.2.2 Chemical and Physical Laboratory

5.2.2.1 An X-Ray fluorescence spectrum is to be made of a random sample and this compared with a standard sample spectrum.

5.2.2.2 The specific gravity is to be determined by weighing the sample in air and in water and calculating the sample volume. Specific gravity should be greater than 2.850.

### 6.0 PRECAUTIONS

6.1 Refer to Beryllium Safety Precautions S.N. 33-2-15A.

6.2 Do not use lubricants. Handle parts with gloves or tweezers only.

FORM NO. 36-0747 SHEET 2

NAME <b>GIMFOSTER</b>	DATE <b>16 APR 82</b>	BERYLLIUM OXIDE ROD	<b>RAYTHEON</b>	LEXINGTON MASS. 02173
			33-B-713D	
APPROVED			CODE 49956	SH 2

REVISIONS: "A" SCN 12642 16 APR 82

**Packing Information for Vendors**

RAYTHEON

72-3807 (7/91)

## PACKAGING INFORMATION FOR VENDORS

SHEET 1 OF 1

NOMENCLATURE BERYLLIUM WINDOW		PART NO. PIV-1073
INSTRUCTIONS		
<p><b>I. Unit Container</b></p> <p>Each item shall be heat sealed in a suitable size polyethylene bag. Each bag shall be marked so as to identify the item by name. The heat seal shall be air tight.</p> <p><b>II. Shipping Container</b></p> <p>A quantity of items shall be placed in a suitable shipping container in such a manner as to insure that the items can not touch each other. Sufficient damage should be used to prevent item shifrage.</p> <p>Shipping container must insure physical protection of its contents as well as personnel handling container and the environment. The shipping container shall insure carrier acceptance and safe delivery.</p> <p><b>ATTENTION: INCOMING STORES</b> - The Beryllium Control supervisor must be contacted immediately upon delivery of this item. Do not open.</p> <p><b>CAUTION: DO NOT OPEN POLYETHYLENE BAGS UNLESS BERYLLIUM CONTROL SUPERVISOR IS PRESENT AND SAFETY MEASURES APPLICABLE TO THIS ITEM HAVE BEEN TAKEN.</b></p>		
<p>RECEIVED MAR 3 1991 NATIONAL BERYLLIUM CORP</p>		<p>ENGINEER <i>[Signature]</i></p> <p>APPROVED <i>[Signature]</i></p> <p>DATE 2-17-71</p> <p>REVISION 1</p> <p>AO 65580</p>

H O O 1 A

**Raytheon Plan and Specification for Insulator, Window**



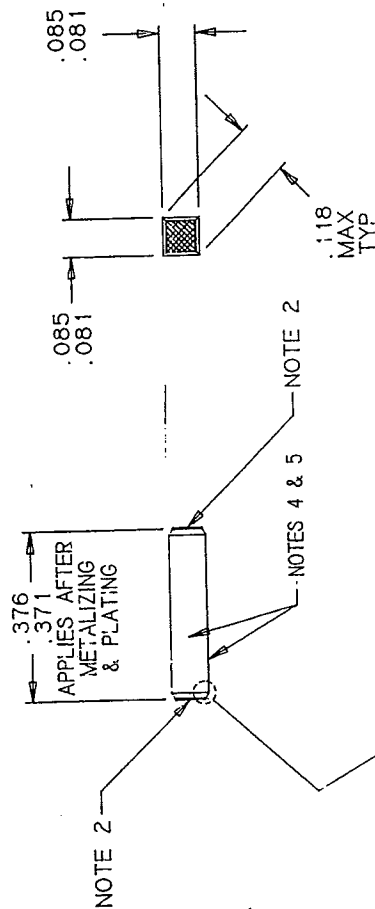
**Raytheon Plan and Specification for Pin, Square – Plated**

PART NO.	STANDARD	PROCESS
G520644-001	4.0	---
G520644-001A	4.0 & 6.6	NOTE 2.1
G520644-001B	4.0 & 6.7	NOTE 2.2

## NOTE(S):

- 1-MATERIAL: BERYLLIA PER RAYTHEON PURCH SPEC 655039 (SEE APPROVED SOURCE)
- 2-THESE SURFACES TO BE PROCESSED AS FOLLOWS:
  - 2.1-METALIZE (80%Mo/20%Mn) .0005-.0015 THICK
  - 2.2-PLATE AS FOLLOWS:
    - 2.2.1-NICKEL PLATE .0003 MIN THICK
    - 2.2.2-FLASH COPPER PLATE .0001 MAX THICK
    - 2.2.3-SILVER PLATE .0002-.0004 THICK
  - PLATING AREA: .009 SQ. IN.
- 3-PART TO PASS FREELY THRU A .086 CAMBER GAGE .375 MIN LONG
- 4-THESE SURFACES SHALL BE FREE OF METALIZING
- 5-UNMETALIZED SURFACES SHALL BE FREE OF ANY GLAZED LIKE APPEARANCE AND SHALL BE CAPABLE OF SUBSEQUENTLY ACCEPTING A CARBON COATING
- 6-PART SHALL BE FREE OF CRACKS, PITS, VOIDS, BLISTERS ETC.
- 7-PART SHALL MEET THE REQUIREMENTS OF RAYTHEON'S PURCH SPEC'S 655039 & G203688
- 8-ONLY THE ITEM DESCRIBED ON THIS DRAWING WHEN PROCURED FROM THE VENDOR(S) LISTED HEREON IS APPROVED BY RAYTHEON COMPANY FOR USE IN THE APPLICATION(S) SPECIFIED HEREON. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR APPROVAL BY RAYTHEON COMPANY. IDENTIFICATION OF THE APPROVED SOURCE(S) HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY AS A SOURCE OF SUPPLY FOR THE ITEM DESCRIBED ON THE DRAWING.

SOURCE(S) OF SUPPLY	
VENDOR	VENDOR(S) PART NO.
GENERAL CERAMICS, INC NATIONAL BERYLLIA DIV. FIRST AVE. HASKELL, NJ 07420	



## SOURCE CONTROL DRAWING

QTY REQD	ESCA NO.	PART NO. OR IDENTIFICATION NO.	DRAWING OR SPECIFICATION NO.	NON-ENCLOSURE OR DESCRIPTION	FIND NO.

CONTR. NO.		PARTS LIST	
DR. NO. RAYNS-ORD	3/2/97		
CHK. <i>[Signature]</i>			
APPROVED			

UNLESS OTHERWISE SPECIFIED	ALL DIMENSIONS ARE IN
INCHES	MILLIMETERS
1 PLACE DECIMALS	2 PLACE DECIMALS
1 PLACE DECIMALS	2 PLACE DECIMALS
MATERIAL	SEE NOTE 1
USED ON	
NEXT ASSY	
APPLICATION	

MPA 150SG NYS	QKW 1818 NYS	QKW 1723 NYS	QKW 1701 NYS	QKW 1671 NYS

Raytheon Company Lexington MA 02173	
DRAWING TITLE	PIN, SQUARE-PLATED
DRAWING NO.	G520644
SIZE	A
SCALE	5:1
SHEET	1 OF 1

INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100, ANSI Y14.5M-1982

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**Raytheon Plan and Specification for Tab (Heat Spreader)**



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